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## MANAGEMENT PLAN (U)

### VOLUME VII

# Apollo Extension Systems / *Grumman* Design 378B

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(NASA-CR-75962) APOLLO EXTENSION SYSTEMS -  
LUNAR EXCURSION MODULE. VOLUME VII -  
MANAGEMENT PLAN FINAL REPORT /PHASE B/,  
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APOLLO EXTENSION SYSTEMS-LUNAR EXCURSION MODULE

Payload Integration Addendum to Phase B Final Report

*Grumman* Design 378B

prepared for

National Aeronautics and Space Administration  
Manned Spacecraft Center  
Advanced Spacecraft Technology Division  
Houston, Texas 77058

by

Grumman Aircraft Engineering Corporation

VOLUME VII MANAGEMENT PLAN (U)

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Contract No. NAS 9-4983  
ASR 378B Addendum

January 1966

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## PREFACE

This report presents results of the Payload Integration Addendum to the Phase "B" Preliminary Definition Study (Contract NAS 9-4983), The Lunar Excursion Module (LEM) for use in Apollo Extension Systems (AES). The objective of the addendum study was to develop preliminary engineering and program definition data related to payload integration for Alternate Apollo LEM Missions. These missions are referred to, in this report, as Phase I Flights.

The volumes comprising this report follow:

- I    Experimenters Handbook - LEM Utilization
- II   Mission Description Summary
  - Part 1      Flight 507
  - Part 2      Flight 509
  - Part 3      Flight 511
  - Part 4      Flight 214
  - Part 5      Flight 216
- III   Engineering Studies/Mission Analysis
- IV   Engineering Studies/Experiment Definitions
  - Part 1      Flight 507/511
  - Part 2      Flight 509
  - Part 3      Flight 214
  - Part 4      Flight 216
- V    Engineering Studies/Vehicle Design Integration
- VI   Program Requirements
- VII   Management Plan

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## 1 INTRODUCTION

The primary management task of the LEM Lab/Experiment Integration effort is to direct the development of integrated flight spacecraft capable of accomplishing specified experimental objectives.

With particular relevance to this program, integration of experiments into AES LEM Vehicles requires an accurate, up-to-date knowledge of:

- The LEM spacecraft
  - payload/spacecraft interface implications
  - potential utilization of spacecraft and subsystems performance capability
- The experiment payload
  - experiment requirements
  - experiment compatibility with the crew, spacecraft, and spacecraft test procedures, GSE, facilities, prelaunch checkout, and flight operations.
- The overall program requirements
  - mission objectives
  - flight launch schedules

The objective of Payload Integration management is to provide LEM-Lab spacecraft satisfying specified technical requirements within cost budgets and schedules.

To accomplish this objective requires:

- Program Plan
- Program Organization
- Management Control Procedures

The implementation of a program plan requires management control over numerous activities including:

- Engineering
- Manufacturing
- Procurement

Management of engineering activities, related to this program, includes control over development and implementation of:

- Spacecraft/payload interfaces
- Spacecraft equipment to make a basic LEM Lab compatible with the experiment payload
- Auxiliary equipment required to support the flight spacecraft.

Similar control is exercised over manufacturing and procurement activities, and all aspects of the program related to the development and support of an integrated flight spacecraft.

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This document presents a management plan for payload integration of Phase I LEM Labs that is integrated with the development of the basic Lab spacecraft.

The document contains the following major sections:

- Organization
- Responsibilities of Key Personnel
- Summary Program Schedule
- Program Controls
- Manpower Requirements
- Budgetary Costs

## 2 ORGANIZATION

### 2.1 ORGANIZATION STRUCTURE

The payload integration effort during the Development/Operations Phase will be handled within the same program organization proposed for the total AES Program. This organization is planned to economically handle the AES baseline vehicle as well as the payload integration. The basic organization and controls were described in Volume XXVI Management Plan, Apollo Extension Systems--Lunar Excursion Module, Final Report, submitted 8 December 1965. Significant portions of this description are applicable and therefore are reproduced in this report.

The program organization shown in Fig. 2-1 is proposed for the AES Program including Payload Integration. Dr. R. H. Tripp heads the organization as Program Director. He reports to Grumman President, E. Clinton Towl, from whom he derives the authority to command all corporate resources required for the program.

The organization consists of key managers assigned exclusively to the program and reporting functionally and administratively to the Program Director. Each manager is individually accountable for planning and meeting the cost, schedule and performance goals which collectively constitute the overall Program objectives. The responsibilities of each manager have been carefully defined to prevent duplication of effort and to promote clear understanding of accountability. For example, each subsystem will be handled both within the Grumman Corporation and at the subcontractor's plant by a Subsystem Manager who will be accountable for his subsystem(s) until installed in a vehicle. Similarly, the payload integration effort will be the responsibility of the Assistant Program Manager-Payload, who will be accountable for the successful integration of the experiments into the Phase I Laboratory. Each functional manager will direct an organization of technical and management specialists drawn from the functional groups within the Corporation. Assignment of, and changes in, Program personnel on all levels requires the approval of the Program Director.

Studies of the proposed organization will continue during the Definition Phase. As a result of these studies and additional discussions with NASA, the organization for the Development/Operations Phase will be finalized.

### 2.2 FEATURES OF THE ORGANIZATION

The proposed organization takes full advantage of the experience gained on the LEM, OAO, and current AES definition programs, and provides for:

- Orderly transition of management control from the Definition Phase to the Development/Operations Phase of the program
- Clear and understandable delineations of responsibility, authority and accountability
- Program evaluation and control through a Control Staff which serves the Program Director and backs up the control elements within the functional operating groups

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- Deliverable end-item accountability
- Subcontractor control through Subsystem Managers
- Complete control of experiments integration through an Asst. Program Manager-Payload
- Total materiel control through a Materiel Manager
- Program evaluation and guidance by a top management Review Board

#### 2.2.1 Organization Planning Based on Overall Objectives

The proposed organization has been planned to meet the needs of the overall Program. The unshaded boxes indicate functions which will be staffed and operating at the inception of the Definition Phase. As the Definition Phase progresses, the functions represented by the shaded boxes\*, and possibly other functions, will be implemented as required to meet specific program requirements. By the start of the Development/Operations Phase, the complete organization will be staffed and operating as an entity.

Along with the organization transition, in some instances, there will be a change in management and supporting-level personnel. In this way, as experienced people from LEM and OAO become available, they will replace the developmental type personnel who are expert in meeting AES definition requirements.

#### 2.2.2 Clear and Understandable Delineations of Responsibility, Authority and Accountability

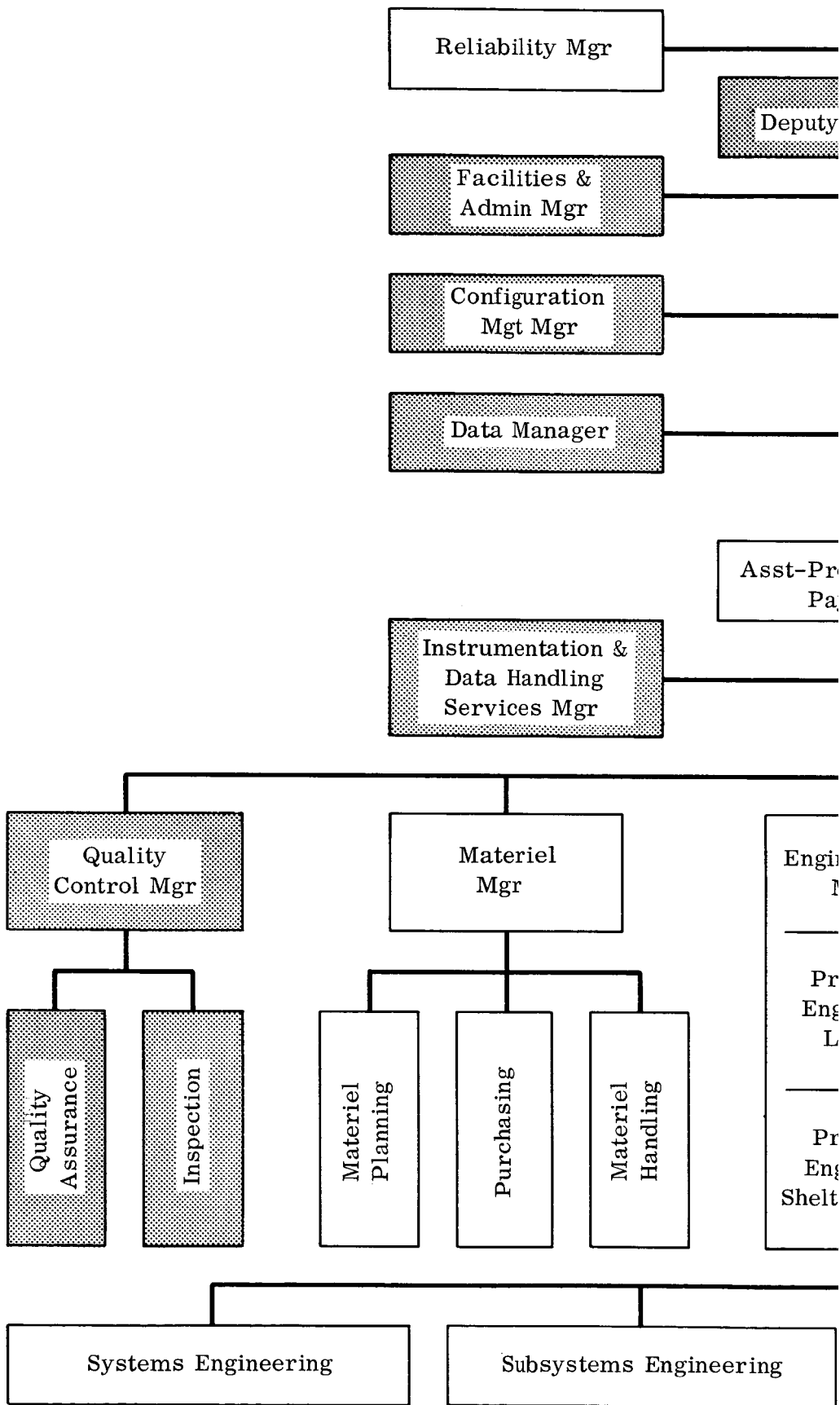
Overall accountability for the Program has been assigned to the Program Director, by the President of the Grumman Corporation. The AES Program Director, in turn, has delegated specifically defined charters of responsibility, authority and accountability to all key managers on the Program. These charters are presented in this Management Plan under Section 3, "Responsibilities of Key Personnel."

#### 2.2.3 Evaluation and Control Through a Control Staff

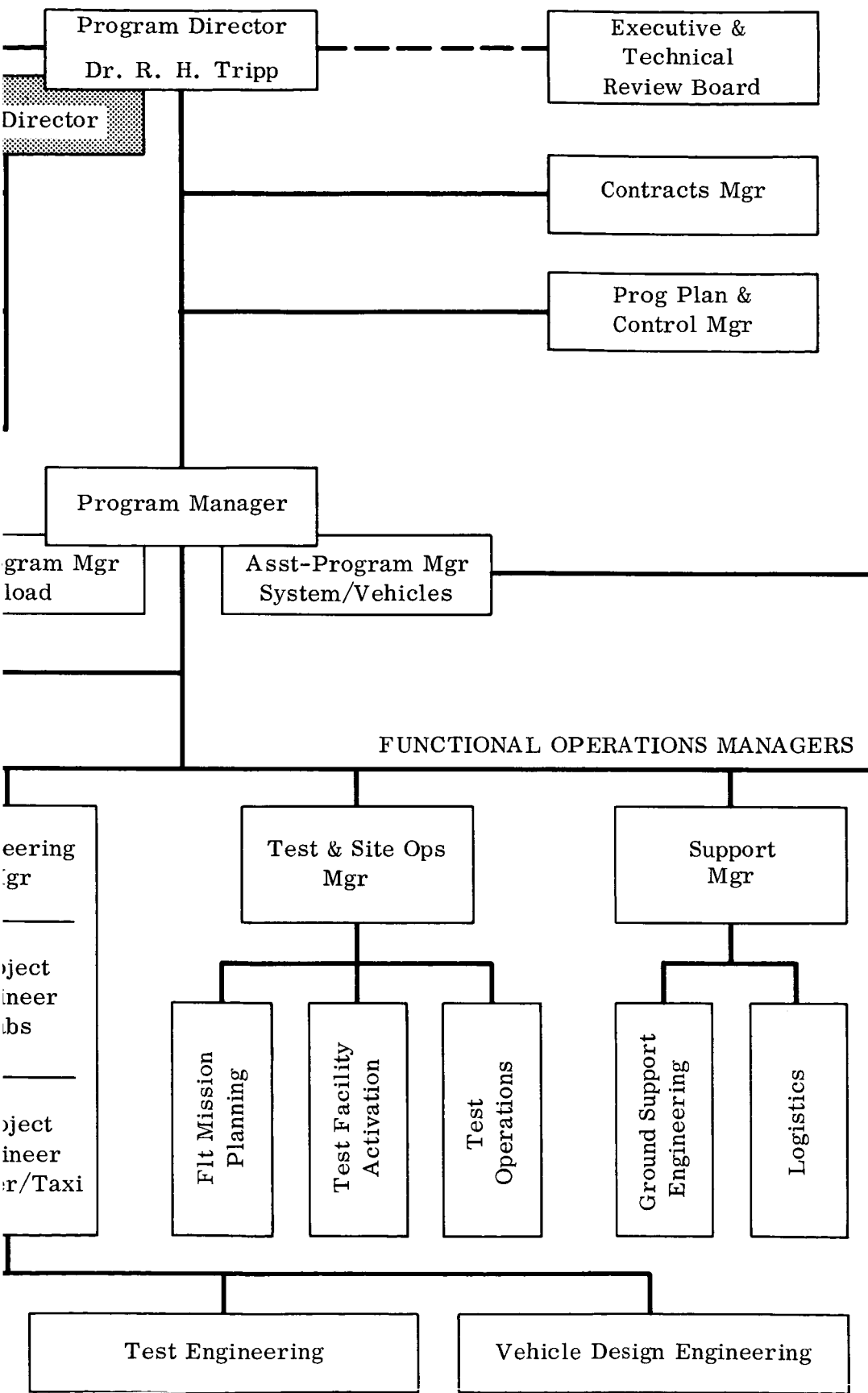
The Program Director's Control Staff consists of specialists in:

- Reliability
- Facilities and Administration
- Configuration Management
- Data Management
- Contracts
- Program Planning and Control

\* NOTE: At the outset of the Definition Phase, all required activities associated with these functions will be supplied by portions of the organization which are already operating and have the qualified personnel. For example, individuals in the Test and Site Operations Group and in the Support Group will continue their facilities planning activities until a Facilities and Administration Manager is assigned.



2-3-1



2-3-2

NOTE: Shaded Boxes Designate Activities Which Will Be Staffed & Phased-In During the Definition Phase

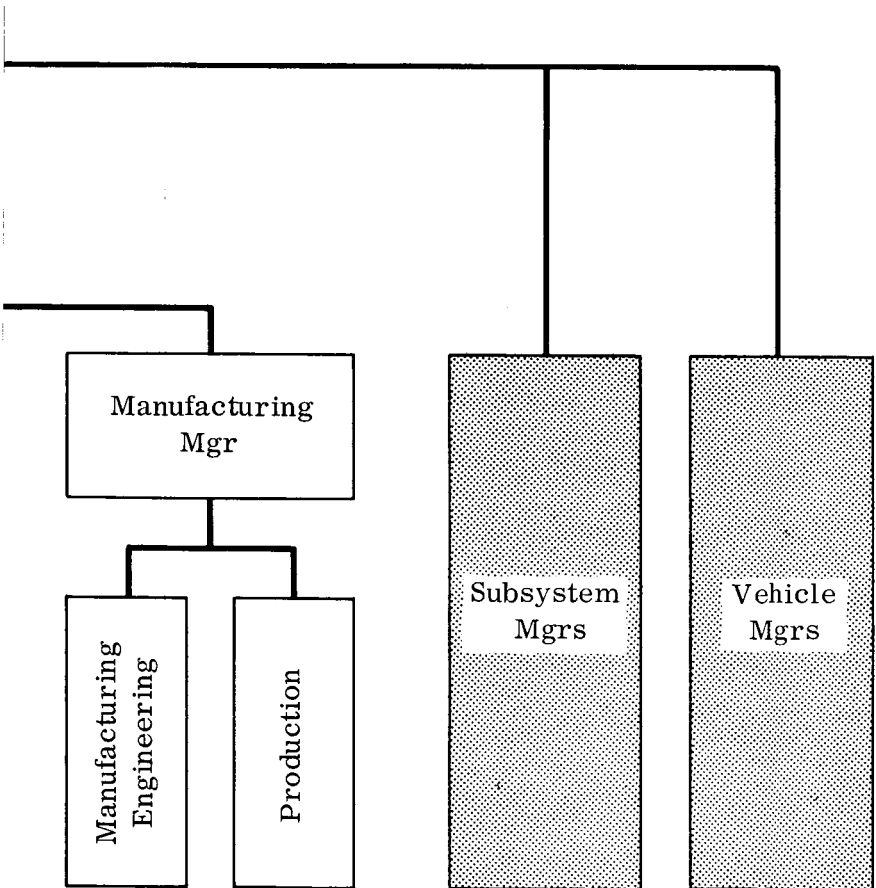


Fig. 2-1 Grumman AES Program Organization Including Payload Integration Functions

2-3/2-4

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The Control Staff will coordinate the development of plans and the definition of criteria against which progress will be measured. They will monitor progress against plans in their respective specialties, detect actual or indicated deviations from these plans and recommend corrective action to the Program Director, Deputy Director, Program Manager, Ass't. Program Manager-Payload, Vehicle, Subsystem and Functional Managers as appropriate. The Staff will have at its disposal a full complement of planning and control techniques and systems.

The fact that the Control Staff reports directly to the Program Director or Deputy Director will permit it to serve as an independent check of program operations and progress. It will also serve to expedite action from the Vehicle, Subsystem and Functional Managers in supplying data that is necessary for the monitoring and control of the Program.

#### 2.2.4 Deliverable End-Item Accountability

Accountability has been established for deliverable end-items down to the lowest level of detail. Vehicle Managers are accountable for their specific vehicles from inception to launch; Subsystem Managers, for subsystems from inception to installation and proper operation in a vehicle; and designated functional managers for detail items such as spares, drawings, training devices and support manuals.

#### 2.2.5 Subcontractor Control Through Subsystem Managers

Subsystem Managers will control the efforts including cost, schedule and performance parameters, of all major subcontractors and in-house groups associated with their subsystems. Each Subsystem Manager will establish a complete subsystem plan based upon inputs from all groups involved. Using this plan as a control base, the Subsystem Manager will: apply review, evaluation and approval procedures; monitor physical progress; assign residents at subcontractor's plants; and impose any other controls individual situations may require to meet cost, schedule and performance goals.

#### 2.2.6 Control of Payload Integration

The Assistant Program Manager - Payload is the focal point at a management level for establishing and maintaining a satisfactory working relationship between the Contractor and NASA with regard to payload, the experimenter, and experiment Associate Contractor. Because payload integration is a uniquely complex task and involves all of the functional elements of the AES Organization, this Manager's position has been selected to insure him authority to draw upon and direct, as required, the resources required to effect integration. His primary responsibility is to ensure maximum accomplishment of technical objectives within the practical constraints of efficient utilization of existing Apollo hardware. By devoting undivided attention to the experiment payload programs and exercising his authority to draw on the resources of all functional elements of the organization he will ensure that technical, cost and schedule trade-offs are made to accomplish his primary responsibility. When and if such trade-offs indicate the necessity for changes on the experiment payload side of the spacecraft experiment interface, the Assistant Program Manager - Payload is responsible for initiating and effecting the interface coordination with NASA, Experimenter and Experiment Associate Contractor.

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Control of payload integration is a complex task that begins with support of NASA's Mission Planning Task Force (MPTF) where mission objectives, constraints and requirements on all elements of NASA's Apollo System are established. From the mission definition base provided by the MPTF the Payload Integration Contractor conducts detailed analyses and trade-offs which establish detailed pre-flight requirements on the vehicle, the experiment payload, and the interfacing structure and equipment (compatibility package). Performance and Interface Specifications are generated by the vehicle Contractor for NASA's use in generating specifications to the Experiment Associate Contractors. The Payload Integration Contractor initiates and maintains liaison between the vehicle and experiment contractors to accomplish the coordination that will lead to the detailed Interface Control Documents (ICD's) generated by the vehicle contractor and approved and signed by the Experiment Contractor. As design and development progress in vehicle, experiment and compatibility package areas, the Payload Integration Contractor expands the ICD's to cover Ground Support Equipment. Ground Operational Equipment, facilities and training interface considerations. Further, as design and development progress and problem areas occur, the Payload Integration Contractor conducts trade-off studies to ensure that the solution to problems is continually effected in the interests of fulfilling the basic experimental mission objectives of the program.

#### 2.2.7 Total Materiel Control

The Materiel Manager has complete accountability for all materiel planning, procurement, and handling. He is the focal point for the coordination and control of all materiel from request or purchase through ultimate delivery and acceptance by the end user.

The Assistant Program Manager-Payload is accountable for the individual GFE experiment packages and utilizes the services of the Materiel Manager as required in discharging this responsibility.

All procurement activities will capitalize on Grumman's LEM experience through the use of personnel with LEM backgrounds as well as through continued use of LEM qualified vendors, with NASA approval.

#### 2.2.8 Top Management Review Board

The AES Program, including the payload integration effort, will be guided, and its performance regularly evaluated, by a top management review board which includes all of the senior executives who currently review the LEM Program. The Board includes:

- Wm. T. Schwendler, Chairman of the Executive Committee
- George F. Titterton, Sr. Vice President
- Richard Hutton, Sr. Vice President
- I. Grant Hedrick, Vice President - Engineering
- Edward Nezbeda, Vice President - Manufacturing
- J. G. Gavin, Vice President - LEM Program Director
- John Lentini, Director - Contracts
- William Robertson, Manager - Procurement
- Hugh McCullough, Programming

### 3 RESPONSIBILITIES OF KEY PERSONNEL

The charters of responsibilities of all key AES Program personnel are included in this section. These charters have been carefully prepared in order to avoid overlapping responsibilities and assure the accomplishment of all program tasks.

#### DR. RALPH H. TRIPP, PROGRAM DIRECTOR

Dr. Tripp, the Program Director, is responsible for the development, production, test and operational support of all Apollo Extension Systems, responsive to the needs of NASA...on schedule and within cost. He:

Plans overall program objectives based upon NASA AES Program requirements

Plans and implements the program organization to meet these requirements

Plans and assigns charters of responsibilities

Plans and issues program policies

Plans for the timely availability of manpower, facility and financial resources required for the program

Directs, through a Program Manager, all functional operations personnel

Directs, personally and through a Deputy Director, the Program Control Staff

Serves as the executive management contact with NASA, subcontractors, LEM and other Corporate activities

Reviews program progress and evaluates status relative to planned program objectives

Reports program progress and status to the President of the Corporation, and to the Executive and Technical Review Board

Reviews and approves all progress reports submitted to NASA.

#### PROGRAM MANAGER

The Program Manager is responsible for the management of the day-to-day operations of the Program within the policies established by the Program Director. Specifically, he:

Directs all functional operations personnel

Directs the preparation of operating procedures for program reviews, communications, and other day-to-day activities within the Program Organization

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Serves as Program Management contact with NASA, subcontractors, LEM and other Corporate activities

Approves all technical reports and documents submitted to the customer or released for manufacture

Reviews and approves all major technical decisions which can affect cost and schedule compliance

Supervises subcontractor control activities through Vehicle, Subsystem, and Materiel Managers by:

- Monitoring subcontractor competitions, evaluations, negotiations, and change actions

- Guiding evaluations relative to the effects of subcontractor changes on cost, schedule and technical requirements

- Reviewing on an exception (deviation from plan) basis, subcontractors cost and progress reports

Conducts weekly, program status and progress meetings using pre-announced agenda. Reviews problem areas, assigns action items and associated deadlines.

Reports Program status and progress to the Program Director every week

Serves as Chairman of the Configuration Control Board.

#### ASSISTANT PROGRAM MANAGER-PAYLOAD

The Payload Manager's primary responsibility is to insure maximum accomplishment of the experimental objectives of the AES Program within the practical program constraints of cost, schedule and efficient utilization of existing Apollo hardware. He fulfills this responsibility by managing the integration of the experiment payloads into the AES Phase I Laboratory. He:

- Assists NASA in design and development of the experiments

- Supports NASA's early and continuing mission planning from which the mission objectives and mission requirements of all elements of the Apollo System, such as spacecraft, ground support, MSFN are derived

- Initiates and insures maintenance of control of interfaces of the experiment payloads with the spacecraft, ground support and operational equipment, facilities and training

- Establishes and insures maintenance of liaison between the experiment contractors, experimenters and the baseline vehicle organizational elements to assure mutual understanding of interface requirements and constraints

Reviews and approves all Performance and Interface Specifications prepared by Grumman for the experiment payload interfaces

Reviews and approves the Phase I Laboratory Experiment Handbook which delineates the interface requirements and constraints

#### ASSISTANT PROGRAM MANAGER - SYSTEM/VEHICLES

The System-Vehicles Manager's primary responsibility is to insure accomplishment of the objectives of the AES Program within the practical program constraints of cost, schedule, and efficient utilization of existing Apollo hardware. He fulfills this responsibility by managing the efforts of the Subsystem and Vehicle Managers. He:

Assists the Program Manager in discharging his responsibilities

Acts directly for the Program Manager in his absence

Reviews and approves the overall vehicle and subsystem plans to insure complete compatibility with Program objectives

Reviews subsystem and vehicle progress and status on a regular basis

Participates in the selection of the best qualified subcontractors.

#### ENGINEERING MANAGER

The Engineering Manager is responsible for the design and development of subsystems and vehicles and for the successful operation of the end product. He:

Directs all engineering design and development effort (including subcontractors') with regard to the AES Vehicles

Directs Engineering Reliability and Maintainability efforts

Provides and monitors a detailed schedule and manpower usage plan for all engineering design and development effort consistent with approved program budgets and schedules

Is responsible for the definition of contractual and specification requirements for the basic vehicle configurations and associated performance

Is responsible for, and approves the definition of all systems checkout requirements, the establishment of all GSE performance requirements, the establishment of an overall system tolerance structure for both performance evaluation and checkout, and the functional and environmental compatibility between GSE and all flight test vehicles

Prepares and approves detail specifications including test requirements for all AES vehicle components and subsystems to be procured from subcontractors

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Approves all technical reports and documents submitted to the customer or released for manufacture and/or test

Participates in monitoring subcontractor technical performance

Participates as a member of the Configuration Control Board.

#### VEHICLE MANAGERS

Each Vehicle Manager is responsible for the effort associated with a specific vehicle from inception to launch. He:

Establishes an overall vehicle plan which covers development, manufacture, and test of the vehicle and delineates support requirements

Reviews and approves vehicle system and subsystem specifications and test plans

Reviews and approves modification package and compatibility package specifications and test plans

Controls cost, schedule, and technical performance against the vehicle plan and utilizes whatever controls are necessary to assure attainment of cost, schedule, and performance goals associated with his vehicle

Reports vehicle progress and status to Program Manager on a regular basis.

#### SUBSYSTEM MANAGERS

Each Subsystem Manager is responsible for the in-house and subcontractor effort associated with a specific major subsystem from inception to incorporation in a vehicle. He:

Establishes an overall subsystem plan which covers the design, development, manufacture, procurement and test of the subsystem and delineates support requirements

Reviews and approves subsystems specifications for in-house or subcontractor effort

Evaluates subcontractor cost and technical proposals and participates in the selection of the best qualified subcontractor

Controls in-house and subcontractor cost, schedule and technical performance against the overall plan, and utilizes whatever controls are necessary to assure the attainment of cost, schedule and performance goals associated with his subsystem

Reports subsystem progress and status to Program Management on a regular basis.

## RELIABILITY MANAGER

The Reliability Manager is responsible for defining overall reliability objectives of vehicles, support equipment and associated publications.  
He:

Interprets NASA requirements, establishes the Grumman Reliability Plan and monitors performance against this plan

Evaluates design definitions for conformance to customer reliability requirements

Examines trade-offs in applicable specifications to determine areas in which requirements can be relaxed to reduce costs without affecting mission effectiveness

Coordinates the development of subcontractor reliability plans

Coordinates with Engineering reliability and maintainability activities

Develops quality standards for work to be accomplished

Participates as a member of the Configuration Control Board.

## CONTRACTS MANAGER

The Contracts Manager will be responsible for all aspects of prime contract administration. He will also participate in the preparation and updating of all program cost and work authorization budgets and will be accountable for the administration of these budgets. He:

Participates in the preparation of a Program Financial Plan including cost and work authorization budgets, facility budgets, procurement budgets and funding consistent with contractual requirements

Monitors progress against the Program Financial Plan

Directs Prime Contract Administration including definition of contractual requirements, issuance of cost and work authorization budgets, and cost reports to NASA and Program Management as required

Identifies work scope changes and obtains appropriate contractual coverage

Negotiates the prime contract as well as all addendums and change proposals

Receives cost estimates and prepares all cost proposals

Reviews all contractual documents including those with subcontractors

Coordinates Grumman's response to NASA inquiries for estimates, reviews, investigations, and studies of financial and contractual matters

Participates as a member of the Configuration Control Board.

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#### PROGRAM PLANNING AND CONTROL MANAGER

The Program Planning and Control Manager is responsible for coordinating the development and implementation of overall program plans including integration of all subcontractor activities, anticipated personnel requirements, and program control systems. He will evaluate progress against these plans and provide concise and timely overall program control information. He:

Directs the development and implementation of overall plans, schedules and control systems

Assists in the development and updating of anticipated personnel requirements and evaluates these requirements in terms of budget and overall program plans

Provides Program Management with periodic status reports comparing both Grumman and subcontractor progress against schedule and manhour plans

Develops a PERT/Companion Cost System to encompass the design, development, fabrication and operational phases of the Program

Integrates plans and schedules with the Apollo/LEM Program to achieve optimum utilization of facility, material and manpower resources

Participates as a member of the Configuration Control Board.

#### FACILITIES AND ADMINISTRATION MANAGER

The Facilities and Administration Manager is responsible for coordinating the planning of all AES facilities required at Grumman's Long Island, N.Y. plants and for providing all necessary administrative services. He:

Establishes an overall plan of AES facilities required at Grumman's Long Island, N.Y. plants

Prepares requests, justifications, schedules and other documentation associated with these facilities

Coordinates the utilization of available LEM facilities with LEM Program Management and NASA

Provides the AES Program with necessary administrative services including office management, secretarial and reproduction services, visit clearances and security.

## CONFIGURATION MANAGEMENT MANAGER

The Configuration Management Manager is responsible for developing and implementing a program configuration identification, control and accounting system which meets NASA requirements. He:

Establishes the AES Configuration Management Plan and monitors performance against this plan

Develops, issues and maintains the program configuration identification, control and accounting system

Advises the Materiel, Subsystems and other Managers on identification, control and accounting systems for configuration management on subcontractor efforts

Serves as configuration management interface with the LEM Program

Directs the conduct of Interface Configuration Documentation formal change activities with associate contractors

Monitors in-house and subcontractor activities to assure the uniform application of the configuration identification, control and accounting system

Administers the change control and accounting system for the Program Director.

## DATA MANAGER

The Data Manager is responsible for the identification, selection, validation and control of all contractual data. He:

Reviews the prime contract and subcontracts, and participates in the negotiation of firm data requirements between NASA and Grumman and between Grumman and subcontractors

Develops, issues and maintains data control methods and procedures

Provides maintenance and control of all specifications, specification control drawings and standards

Prepares and monitors data schedules to assure timely receipt of data from subcontractors and to assure timely submission of data to NASA

Takes appropriate action to expedite the preparation and submission of all items of documentation for NASA

Reviews all contractual data prior to submittal to assure completeness and compliance with applicable schedules

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Maintains a contractual data summary which lists all data requirements and Grumman performance in terms of these requirements

Maintains a central data and correspondence file including facilities for identification, storage and retrieval

Receives and processes documentation and validates payment for same.

#### QUALITY CONTROL MANAGER

The Quality Control Manager is responsible for defining overall quality control requirements and for assuring that the AES vehicles and support equipments, including all systems, subsystems, and components meet these requirements and comply with program specifications and standards. He:

Establishes and maintains the Quality Control Plan

Directs all in-house and site Inspection activities, including the development of acceptance test procedures, the supervision of manufacturing test inspection and the maintenance of data and corrective action follow-up

Directs all in-house and site Quality Assurance activities

Obtains and approves subcontractor Quality Control requirements and follows up to assure compliance

Conducts subcontractor quality control audits to assist in source selection

Coordinates the Quality Control Program with NASA

Participates as a member of the Configuration Control Board.

#### MATERIEL MANAGER

The Materiel Manager is responsible for all phases of the procurement of vendor supplied material and request of GFE material (experiments, etc.), including the handling of this material necessary to deliver it to the place and/or person for whom it is intended. He:

Establishes a detailed procurement plan consistent with the approved schedules and budgets

Prepares and justifies (including invitation to quote, obtaining quote, and bid evaluation) recommendations on source selection

Negotiates contracts with approved vendors and prepares justification package

Specifies and obtains from each vendor the data and information required by program management to properly monitor cost, schedule, and technical progress

Transmits to the vendor all official directives involving contractual matters such as purchase orders, cost and/or schedule agreements or changes

Coordinates all material handling associated with GFE and purchased equipment and hardware including: Receiving, Inspection, Storing, Transportation and Inventory

Prepares Material Status Reports as required by Program Management

Participates in Make or Buy Evaluations

Participates as a member of the Configuration Control Board.

#### TEST AND SITE OPERATIONS MANAGER

The Test and Site Operations Manager is responsible for conducting field tests and for the planning, staffing and activation of all the field operations. He:

Establishes an overall Field Test and Site Operations Plan and controls performance against this plan

Provides test mission plans including test and experiment requirements, flight plans, and Operational Time Lines

Directs all field operation tests, including required documentation in accordance with approved plans, schedules and budgets

Directs vehicle checkout operations including required documentation in accordance with approved plans, schedules and budgets

Directs site activation activities including preparation of activation logic, activation task requests and bid packs, and the conduct of facility verification tests

Provides support to the Mission Control Center and the Manned Space Flight Net.

Participates as a member of the Configuration Control Board.

#### SUPPORT MANAGER

The Support Manager is responsible for the procurement and/or design and fabrication of hardware necessary to maintain, operate, and handle the various subsystems, systems, and vehicles during the test and operational phases of the program. His responsibility will also include operational publications and training as well as logistics and spares provisioning. He:

Establishes an overall detailed plan for the provision of Support Facilities and Services and controls performance against this plan

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Directs the design, development and/or procurement of required facilities and equipment in accordance with approved specifications, schedules and budgets

Directs and implements plans and efforts required for proper maintenance of all vehicles

Provides manuals, training courses and facilities such as: operation manuals, maintenance manuals, flight and ground crew training, trainers, simulators and visual aids

Directs and implements an appropriate logistics plan in accordance with an approved schedule and budget

Provides, stores, and maintains required spares in accordance with an approved plan, schedule and budget

Performs acceptance or verification tests on all Support Department supplied hardware and equipment to the satisfaction of the party designated as user of the equipment

Participates as a member of the Configuration Control Board.

#### MANUFACTURING MANAGER

The Manufacturing Manager is responsible for fabrication and assembly of all hardware including necessary tooling and manufacturing processes as well as manufacturing support for testing and field operations. He:

Directs and controls all manufacturing effort including tooling, manufacturing processes, and manufacturing test support

Establishes a detailed tooling, fabrication and assembly plan consistent with approved schedules and budgets

Determines facility requirements for manufacturing and implements action to meet these requirements within approved schedules and budgets

Prepares reports on manufacturing cost, schedule, and manpower status for Program Management

Participates in Make or Buy Evaluations

Participates as a member of the Configuration Control Board.

## INSTRUMENTATION AND DATA HANDLING SERVICES MANAGER

The Instrumentation and Data Handling Services Manager is responsible for servicing the Instrumentation and Data Handling needs of all Program Departments. He:

Directs a comprehensive requirements analysis to:

- Screen test requirements to optimize use of existing equipment and facility capabilities

- Screen instrumentation requests to assure adequate coverage of test objectives

- Effect liaison with Test and Site Operations, Engineering Support and other groups to assure concurrence on test implementation

- Provide data systems engineering to optimize data from measurement to finished data

- Develop methods to meet all data processing requirements

Provides instrumentation services for data acquisition in support of test operations and flights

Provides data processing services including the design and definition of required computer programs, the operation of all equipment required for data reduction and dissemination of flight data received on the ground

Provides Measurement and Calibration services including the preparation of specifications for procurement of transducers required for ground testing and GSE and calibration procedures for physical and electrical measuring equipment. Also provides engineering support to Calibration Laboratories, consulting services to design and installation groups and assistance in vendor/subcontractor liaison

Provides System Design services including:

- Specifications for procurement of equipment to satisfy signal conditioning, multiplexing, recording and data processing requirements of the test program

- Detail design required to install equipment in test articles and facilities

- ICD information on ground test equipment

- Designs for instrumentation equipment built in-house

- Subcontractor/Vendor liaison.

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4 SUMMARY

This section contains the Summary Program Labs, (Fig. 4-1), which indicates the basic schedule for the Phase I Labs. The schedules are based on the schedule for AES Planning, ML-65-1, dated 7 August 1965.

In accordance with NASA contractual requirements, the hardware will be fabricated and assembled to the specifications modified to each particular laboratory mission. Missions currently planned include earth orbit, earth synchronous orbit, and lunar orbit. The vehicles will be used.

LEGEND:

-  Design
-  Development
-  Tool Development
-  Tool & Kit Fabrication
-  Verification
-  Modification Check
-  Experimental Requirement
-  Prototype Requirement
-  Flight Experiment
-  Start Installation
-  Launch

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4-1-1

~~CONFIDENTIAL~~

Phase D

PROGRAM SCHEDULE

Program Schedule - Payload Integration Phase I  
Basic plan for the five flight missions for  
based upon the Flight Mission Assignment Plan  
of 1965.

Requirements, the Phase I Laboratory vehicles  
in LEM configuration at Grumman and subsequently  
in flight configuration at KSC. The Lab I  
will orbit rendezvous, earth polar orbit,  
and flights. Saturn IB and Saturn V launch

Development

Design

Compatibility

Verification

Integration

Integration & Prelaunch

Checkout

Assembly Mockup

Completed

Pre-flight Experiments

Completed

Spacecraft

Elements Required

Experiment

Integration

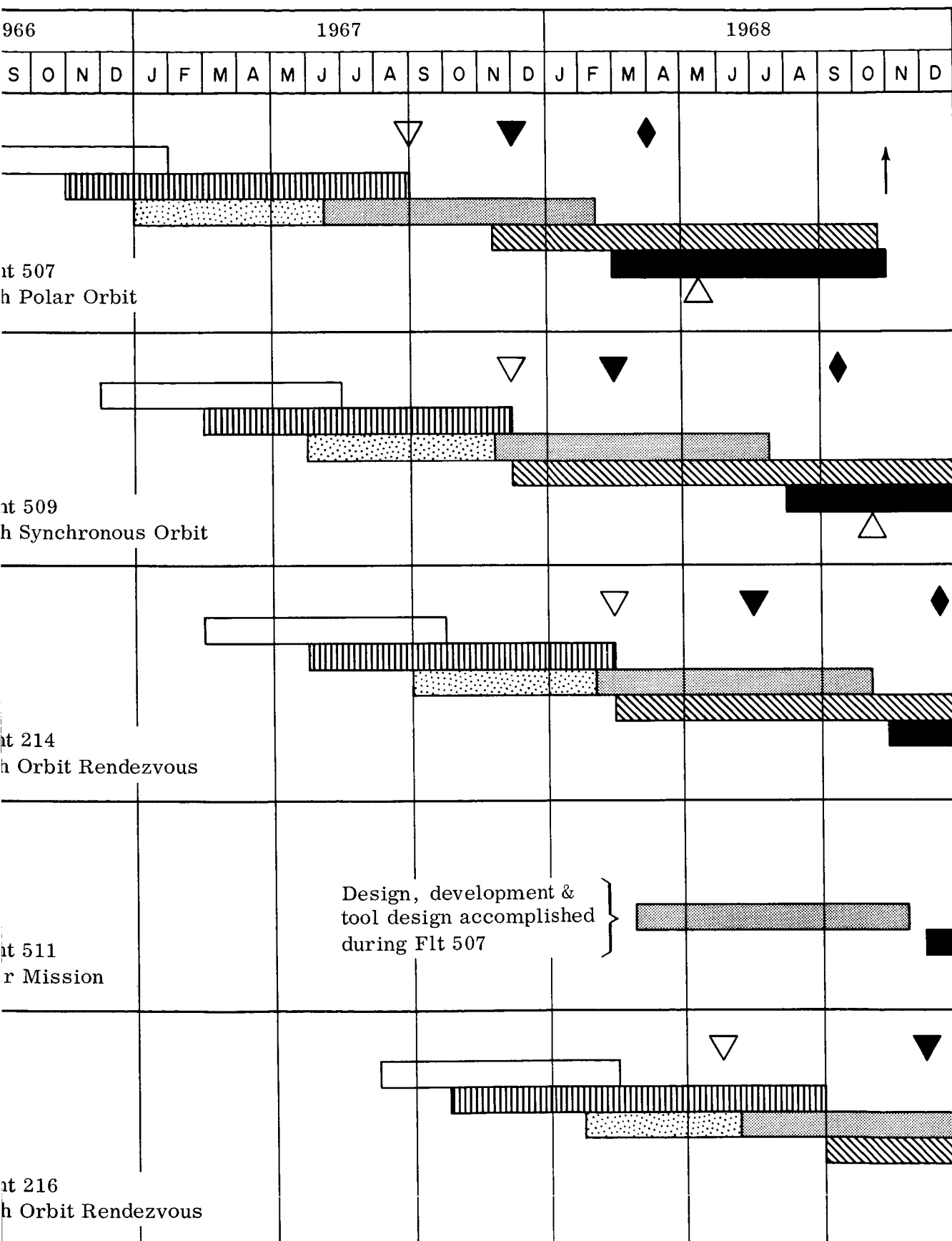
1	
J	A
Flight Earth	
Flight Earth	
Flight Earth	
Flight Lunar	
Flight Earth	

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4-1-2

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Go-Ahead

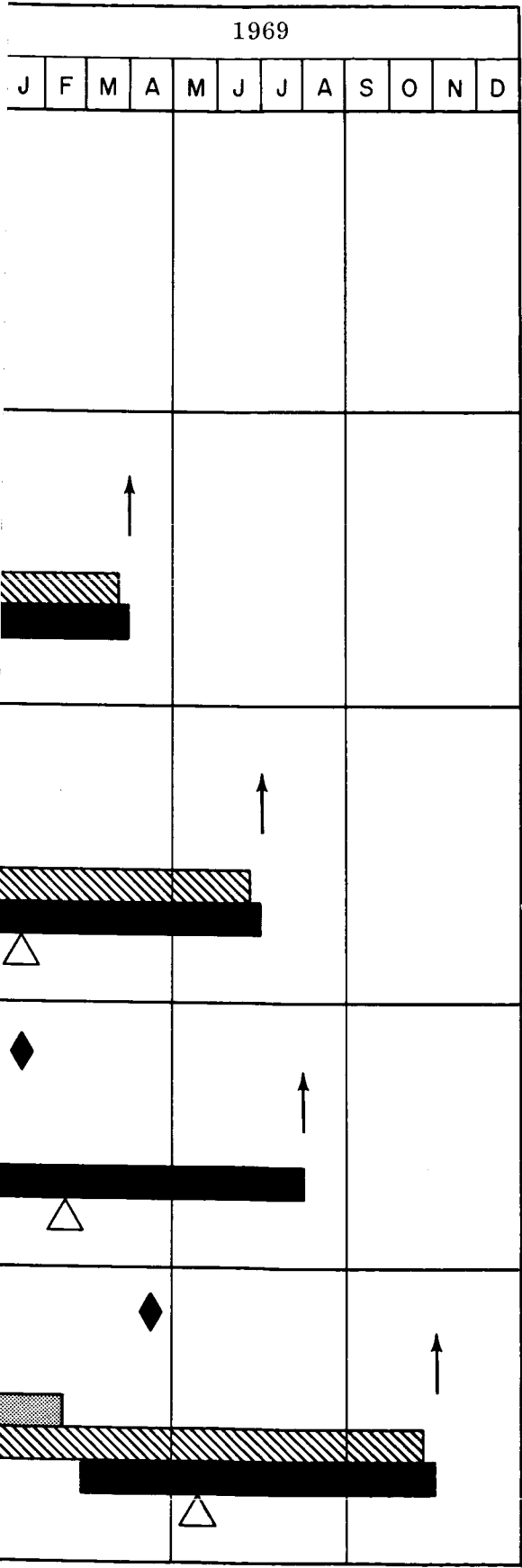


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4-2-1

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4-1/4-2



~~CONFIDENTIAL~~

Fig. 4-1 Summary Program Schedule - AES  
Payload Integration Phase I Labs

4-2-2

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## 5 PROGRAM CONTROLS

The AES Program Director exercises control of all program parameters -- schedule, cost, technical, data, configuration, and subcontractor--through an integrated network of controls. The framework and disciplines of the control network have been established in Phase B and will be expanded to the detail required to effectively control the Definition and the Development/Operations Phases.

### 5.1 SCHEDULE/COST CONTROLS

PERT/Time and cost techniques as outlined in NASA PERT and Companion Cost System Handbook dated 30 October 1962, will be used to develop and control the Development/Operations Phase. Schedules will be controlled by monitoring performance against the milestones shown on the PERT Networks. Cost Data will be collected and controlled through the use of the following three in-house control and reporting systems:

- Manhour Planning and Control System provides a detailed time-phased plan of manhour expenditures by labor category and related work packages. Man-hours charged are recorded in weekly computer print-out reports comparing actual vs. planned expenditures. Deviations from the plan are identified for corrective action
- The Manpower Planning and Control System converts the manhour plans into anticipated personnel requirements by labor category and thereby provides the basis for effective staffing of the Program
- The Material Planning and Control System provides internal control of material costs through a time-phased commitment and expenditure plan. Commitments and expenditures are compared to the plan on a monthly basis and deviations are displayed for decision and action.

The reports associated with these systems are shown in Fig. 5-1.

### 5.2 TECHNICAL PERFORMANCE CONTROL

Technical performance monitoring will be realized through a systematic engineering analysis and documentation effort to assure that every technical decision and engineering design solution is subjected to appropriate review and approval before succeeding sets of technical decisions and engineering solutions are made.

The key elements of the AES design control program are:

- Incorporation of all technical aspects of the program into a detailed technical program plan
- Detailed performance specifications and requirements
- Detailed test specifications, procedures and reports
- Effective change control

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- Technical status reporting from all internal and subcontractor activities
- Formal design review
- Provision for contingency steps to implement recovery action if and when required.

### 5.3 DATA MANAGEMENT

Complete and effective documentation control on the AES Program will result from efficient utilization and control of information processing under the direction of the Data Manager.

He will, within the policy guidelines of NASA and the AES Program Director:

- Supervise the Program Documentation Organization in compliance with the NASA Control System
- Assure maximum utilization of the existing LEM documentation
- Assure meeting all the contractual data requirements of the AES Program.

During the initial portion of the Development/Operations Phase, the Specification Unit will assist in the preparation of necessary specifications. In general, these will be the systems performance/design requirements specifications and contract end-item detail specifications for primary equipment, facilities and critical components. All specifications will be prepared to meet the intent of NPC 500-1, "Apollo Configuration Management Manual." Where appropriate, the existing LEM specifications will be used as the basis for AES specification.

A Data Requirements Control Unit and a Validation Unit will also be active during the Development/Operations Phase. The Data Requirements Control Unit will:

- Negotiate firm data requirements between Grumman and NASA, and between Grumman and its vendors
- Institute control methods and procedures
- Schedule timely submittal of data from vendors
- Schedule timely submittal of data to NASA
- Review all contractual data prior to submittal for completeness and compliance with applicable requirements and schedules
- Record and maintain a contractual documentation summary for program review.

The Validation Unit will monitor the receipt of and control payment for vendor documentation submitted in the Development/Operations Phase.

Other Data Management Units will be phased-in to provide a complete, functioning Data Management Organization.

In the interest of economy and efficiency, it is intended to adapt the identification system procedures and the documentation control system of the LEM Program to the needs of the AES. The aim is optimum commonality and use of drawings, documents,

and other records. The experience gained on the LEM Program in the management of documentation tailored to the needs of NASA will permit a smooth transition of functions with a minimum of reorientation.

#### 5.4 CONFIGURATION MANAGEMENT

Grumman will maintain effective configuration management on the AES Program through the continued implementation of proven systems and procedures. These systems and procedures reflect Grumman's experience on the LEM Apollo Program.

Implementation of configuration management on the Program will:

- Provide an effective system for management control of changes to prevent unplanned, unauthorized and unnecessary expenditures of resources
- Provide an effective system for verifying the precise configuration of each end-item
- Provide an effective system for maintaining correlation between the contract, the design and the end-item hardware of documentation.

#### 5.5 SUBCONTRACTOR CONTROL

The major portion of subcontractor effort is associated with the design, development, manufacture and test of subsystems. The AES Subsystem Managers will exercise management control of these subcontractors. They will be supported by the Materiel Manager who provides all required procurement services and by other functional operations managers as required.

The specific steps which will be followed to select and control subcontractors are summarized below. The responsible and supporting managers are indicated after each step.

- Establish a clear definition of work to be accomplished in the specifications and vendor requirements documents - including all critical interfaces - (Engineering, Manufacturing and Quality Control Managers - with concurrence of Subsystem Manager)
- Submit work packages, including specifications, to qualified vendors for proposals and quotations (Materiel Manager)
- Review vendors' replies and select the best qualified subcontractors (Subsystem Manager assisted by the Engineering Manager, Materiel Manager, Contracts Manager, Program Planning and Control Manager and other Managers as appropriate)
- Review vendors' replies from a manufacturing standpoint (manufacturing plan, schedule, cost and facilities) to determine best qualified subcontractors (Subsystem Manager assisted by Manufacturing and Materiel Managers)

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- Prepare for and conduct negotiation of price, contract type, general and special provisions, incentive provisions when applicable, work scope specifications and contract schedules (Materiel Manager guided by Subsystem Manager - assisted by Manufacturing Manager and other Managers as appropriate)
- Analyze each subcontractor's proposed program plan to insure complete program integration, and provide a basis of measuring performance and relating costs to specific work areas (Subsystem Manager assisted by Program Planning and Control Manager)
- Award subcontracts to selected vendors (Subsystem Manager through Materiel Manager)
- Regularly appraise the subcontractor's program management with particular emphasis on cost controls, adherence to subcontract and internal schedules, procurement practices, internal control of materials, effective utilization of manpower and cost reduction activities (Subsystem Manager and Materiel Manager assisted by other Managers as appropriate)
- Receive and analyze, for accuracy and compliance with contracted requirements, status and administrative reports submitted by subcontractors (Subsystem Manager assisted by the Materiel Manager and the Program Planning and Control Manager)
- Monitor physical progress of the work and investigate actual and potential schedule slippages (Subsystem Manager assisted by the Materiel Manager)
- Monitor subcontractor's manufacturing activity, establish and maintain status, survey physical progress, investigate problem areas and report to Subsystem and other managers as appropriate (Manufacturing Manager)
- Analyze financial data and weigh the validity of the subcontractor's estimate-to-complete (Subsystem Manager assisted by the Materiel Manager and the Program Planning and Control Manager)
- Assign residents when necessary (Subsystem Manager)
- Analyze PERT submissions (Subsystem Manager assisted by the Program Planning and Control Manager)
- Require the subcontractor's purchasing organizations to establish and maintain proper and sufficient control applicable to lower tier subcontractors (Materiel Manager).

Each Subsystem Manager, or his designee, in conjunction with the Engineering Manager, will maintain effective control of his subcontractors' technical performance by reviewing and approving their:

- Specification control documents
- Designs and reports
- Drawings and design changes
- Test procedures, plans, and reports
- Reliability predictions and trade-off studies
- Failure effects and model analyses
- Maintainability studies and reports.

Effective control of AES subcontractors will result from the implementation and/or refinement of the following during the following during the Development/Operations Phase:

- Detailed delineations of necessary subcontractor control steps
- Specific assignments of responsibility for all steps and interfaces
- Working relationships and lines of communication with LEM subcontractors who will participate in AES
- Assignment of experienced personnel to all facets of subcontractor control.

## 6 MANPOWER REQUIREMENTS

Fig. 6-1 represents the payload integration manpower requirements during the Development/Operations Phase. This staffing profile is time-phased and divided into four basic categories:

- Technical - including basic engineering, support engineering, service and flight test
- Manufacturing - including vehicle fabrication, support fabrication and Quality Control
- Tooling - encompassing tool design and tool fabrication
- Other - covering Program Management, Shipping and Reproduction.

A clear delineation of the task requirements necessary to fulfill this manpower profile will provide a basis for selecting specific individuals for assignment to the program. This selective staffing technique, or "people plan," will be expanded in the Definition and Development/Operations Phases, to take full advantage, without interference, of the people available from the LEM and other Company programs who have experience in design, development, fabrication and test of space hardware and vehicles. Current examinations of Corporate and LEM manpower availability indicate there is, and will continue to be, experienced personnel available to meet the time-phased needs of the Payload Integration Program.

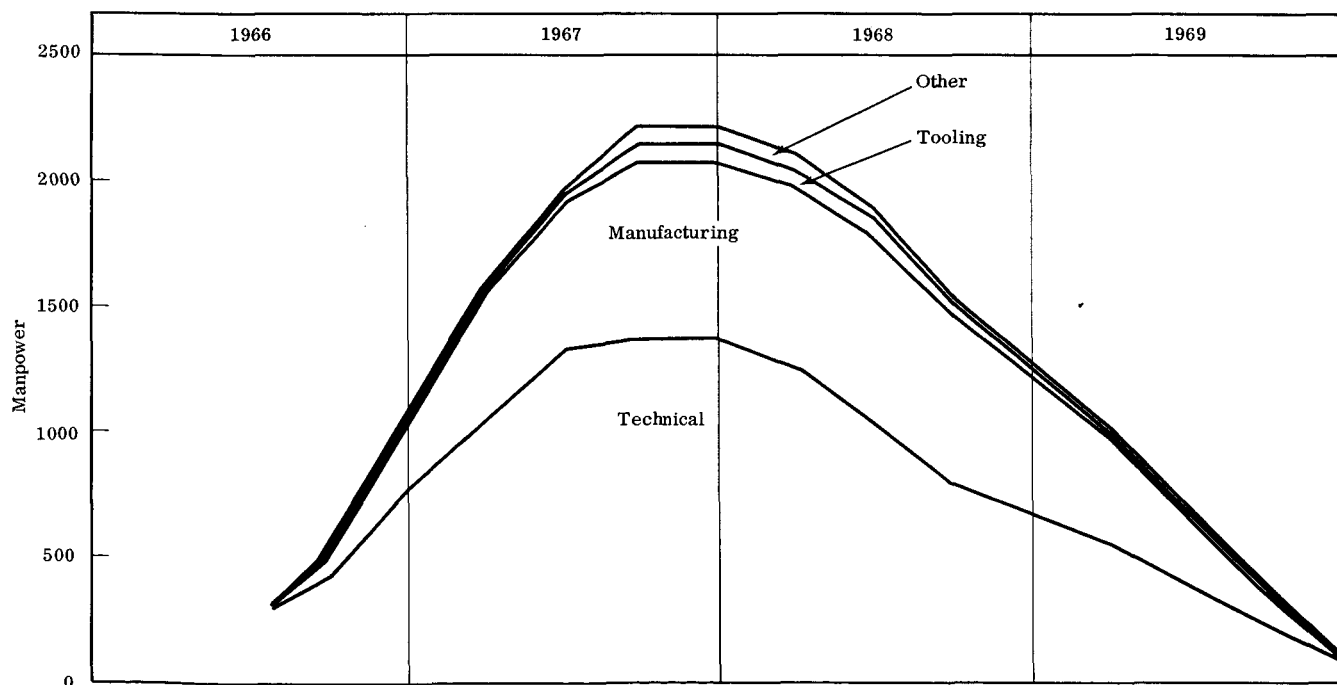


Fig. 6-1 Preliminary AES Development/Operations Phase Manpower Requirements  
Phase I Lab Experiment Integration

## 7 BUDGETARY COSTS

### 7.1 INTRODUCTION

This section presents the budgetary estimated costs - for planning purposes only - of the Phase I Labs Experiment Integration effort required during the Development/Operation phase of the AES/LEM spacecraft program. The effort consists of the following principal categories applied to the 'base-line' Phase I Labs on a per-flight basis:

- Perform mission planning and systems engineering and test.
- Develop and prepare specifications for compatibility equipment/experiment interface.
- Design, fabricate, and install compatibility equipment.
- Provide required GSE and logistic support for compatibility equipment and integrated Experiment/Lab.
- Install experiments and perform integrated checkout and acceptance tests.
- Perform pre-launch checkout and provide launch and flight support - supplemental to base-line requirements.

The costs presented herein, when added to the base-line Phase I Labs budgetary costs given in the Phase B Preliminary Definition Plan Report of the basic contract (Vol. I - 29 October 1965), comprise the Contractor's budgetary cost estimate of the Phase I Lab Program. However, it should be noted that the estimates are based upon the Contractor accomplishing certain of the integration work concurrently with base-line work (e.g.: parallel installation of modification kit and compatibility package). Such scheduling of work, described in detail elsewhere in this report, avoids redundancies of effort and costs which would result from a 'series' operation involving separate contractors for base-line and integration work. Thus, for planning purposes, the costs presented herein should not be assumed to be adequate to cover the multiple contractor case.

### 7.2 FORMATS

The budgetary estimated costs are tabulated, by individual flights/missions, in the following formats:

- FORMAT I - In general conformance with the NASA/MSC Standard Cost Category Structure. Subsystem compatibility equipment costs are itemized on Sheet 2 and the totals are transferred to Sheet I where they are combined with other costs which are not subsystem-related. All cost figures include G&A overhead but no fee is included. All costs are time-phased, i.e., they are based on labor and overhead rates anticipated for the calendar years in which the work is scheduled.
- FORMAT II - In general conformance with MSC Form 207 - Cost Proposal Summary Analysis. The Cost Elements column is modified from the latter to conform to the Grumman cost accounting system. One form for each

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flight plus one form for total program are submitted. The labor and overhead rates shown are composite rates for all calendar years involved.

- FORMAT III - A single sheet form summarizing, by flight and by calendar year, Grumman labor costs and procurement costs.
- FORMAT IV - A tabulation of the labor and overhead rates used in the cost estimates for the calendar years in which the work is scheduled.

### 7.3 MAJOR COSTING ASSUMPTIONS AND GUIDELINES

Detailed costing assumptions and guidelines relative to technical scope, configurations, etc., are presented elsewhere in this volume. The following points are of major significance with respect to the cost estimates:

- Costs for individual flights are based upon a cumulative development program in the sequence described by the schedules in this report. This presumes that certain of the applicable development requisites have been accomplished on prior flights (e.g., Flight 511 development costs are based on prior development of Flight 507, etc.)
- It has been assumed that a prior final-definition study effort will have completed definition of the requirements for the flights/missions covered herein.
- The production/operation work of experiment integration will be performed at KSC, as well as the modification of the LEM's to base-line lab configurations.
- The experiment contractors will provide the necessary technical liaison, hardware, and other support to the integration as is necessary to develop the vehicle/experiment integrated checkout equipment and preparation of test plans and procedures. They will provide the experiment, spares, and bench checkout equipment as GFE, and will conduct acceptance and pre-installation tests on the experiments prior to installation in the lab.
- Costs for travel to experiment contractors' facilities have not been included in the estimates since the number and/or location of such contractors is not yet known.

FORMAT I  
Sheet 1 (Total)

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATION PHASE COST ESTIMATE

Man-hours in Thousands  
Dollars in Millions

FLIGHT NO. 507

FUNCTION  WORK SUBDIVISION	NON-RECURRING						PRODUCTION		SPARES	LAUNCH OPERATIONS	
	Design & Development						FLIGHT ARTICLE				
	R. & D. Eng.		Mfg.		Initial Tooling	Labor	Procure	Total			
	Prime Man-hr. Cost	Subctr	M.T.I. & Support	Devel Ground Test							
Subsystems (From Sheet 2)	304.7 \$ 2.84	\$ 4.32			\$ 1.46	\$ .38	\$ 1.41	\$ .93	\$ 2.34	\$ 1.16	
Non-Subsystem Eng. *	293.9 \$ 3.02		\$ 1.03		\$ 2.64						\$ 1.79
Experiment C/O, Instal, & Integrated C/O	0 \$ 0				.50	\$ .01	\$ .30	\$ 0	\$ .30		
Sub-Totals	598.6 \$ 5.86	\$ 4.32	\$ 1.03		\$ 4.60	\$ .39		Total	\$ 2.64		
Design & Devel. Total					\$ 15.81						
				Support							
G.S.E.	414.0 \$ 3.87	\$ .63	\$ 5.99							\$ .84	
Trainers	10.9 \$ .10	\$ .30	\$ 1.20						Total	\$ 2.00	
Training & Handbooks	55.5 \$ .42	\$ 0									
Totals	480.4 \$ 4.39	\$ .93	\$ 7.19		\$ 12.51						
Program Planning & Management **	107.0 \$ .97	\$ .51			\$ 1.48						
*Includes: G.N.&C. Analysis & Integration Electronic Integration											
**Includes: Program Management											
Design & Development \$ 15.81											
Initial Tooling .39											
Support 12.51											
Production 2.64											
Spares 2.00											
Launch Operation 1.79											
Prog. Planning & Mgmt ** 1.48											
Total \$ 36.62											

Design & Development \$ 15.81  
Initial Tooling .39  
Support 12.51  
Production 2.64  
Spares 2.00  
Launch Operation 1.79  
Prog. Planning & Mgmt \*\* 1.48  
Total \$ 36.62

\*Includes: G.N.&C. Analysis & Integration  
Electronic Integration  
Structural Analysis  
Thermodynamics  
Mass Properties  
Crew Systems  
Sys. Analysis & Integration  
Flt. Test Mission Planning  
Reliability  
System Simulation

\*\*Includes:  
Program Management  
Program Planning  
Quality Program  
Configuration Mgmt  
Data Mgmt  
Reproduction  
Travel & Field Expense

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FORMAT I  
Sheet 2 (Subsystems)

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

Man-hours in Thousands  
Dollars in Millions

FLIGHT NO. 507

Function  Work Subdivision		Design & Development					Initial Tooling	Production			Spares
		R & D Engineering		Devel Ground Test	Total	Flight Article					
		Prime Man-hr Cost	Subctr			Labor		Procure	Total Cost		
Structure (1)		73.3 \$	\$ 0	\$ .03	\$ .71	\$ .24	\$ .27	\$ 0	\$ .27	\$ .03	
Crew Provisions (2)		50.8 \$	\$ 2.57	.58	3.62	.07	.15	.55	.70	.54	
Environ Control		22.3 \$	\$ .02	.24	.47	.01	.12	.06	.18	.07	
Electric Power		60.9 \$	\$ 0	.14	.70	.04	.21	.01	.22	.04	
Reaction Control		1.9 \$	\$ 0	0	.03	0	0	0	0	0	
Communications		35.7 \$	\$ 0	0	.33	0	.10	0	.10	.03	
Guid, Nav, & Control (3)		36.1 \$	\$ 1.70	.44	2.47	0	.17	.30	.47	.44	
Instrumentation		22.9 \$	\$ .03	.03	.28	.01	.04	.01	.05	.01	
Propulsion		0 \$	\$ 0	0	0	0	0	0	0	0	
Final Assy & Accept Test (4)		0.8 \$	\$ 0	0	.01	.01	.35	0	.35	—	
TOTALS		304.7 \$	\$ 4.32	\$ 1.46	\$ 8.62	\$ .38	\$ 1.41	\$ .93	\$ 2.34	\$ 1.16	

- NOTES: (1) Includes Mechanical and Electroexplosive Devices  
 (2) Includes Displays and Controls & Photographic Subsystem  
 (3) Does Not Include G.F.E. Guidance Computer  
 (4) Compatibility Equipment-Installation & Checkout

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATION PHASE COST ESTIMATE

Man-hours in Thousands  
Dollars in Millions

FLIGHT NO. 509

DOLLARS IN MILLIONS

FUNCTION		NON-RECURRING					PRODUCTION		SPARES	LAUNCH OPERATIONS
WORK SUBDIVISION	Design & Development					Initial Tooling	FLIGHT ARTICLE			
	R. & D. Eng.		Mfg.	Devel Ground Test	Labor		Procure	Total		
	Prime Man-hr.	Subctr	M.T.I. & Support							
	Cost									
Subsystems (From Sheet 2)	238.1	\$ 9.46		\$ 1.35	\$ .29	\$ 1.16	\$ 3.30	\$ 4.46	\$ 1.44	
	\$ 2.24									
Non-Subsystem Eng. *	216.2		\$ 1.42	\$ 1.81						\$ 1.21
	\$ 2.24									
Experiment C/O, Instal, & Integrated C/O	7.6			.38	\$ .01	\$ .15	\$ 0	\$ .15		
	.07									
Sub-Totals	461.9	\$ 9.46	\$ 1.42	\$ 3.54	\$ .30		Total	\$ 4.61		
	\$ 4.55									
Design & Devel. Total				\$ 18.97						
			Support						\$ .66	
G.S.E.	642.2	\$ .23	\$ 4.16							
	\$ 6.30									
Trainers	5.6	\$ .03	\$ .12							
	.05									
Training & Handbooks	26.0	\$ 0								
	.21									
Totals	673.8	\$ .26	\$ 4.28	\$ 11.10						
	\$ 6.56									
Program Planning & Management **	59.8	\$ .40		\$ .95						
	.55									
*Includes: G.N.&C. Analysis & Integration Electronic Integration Structural Analysis Thermodynamics Mass Properties Crew Systems Sys. Analysis & Integration Flt. Test Mission Planning Reliability System Simulation										
**Includes: Program Management Quality Program Configuration Mgmt Data Mgmt Reproduction Travel & Field Expense										
Design & Development \$ 18.97										
Initial Tooling .30										
Support 11.10										
Production 4.61										
Spares 2.10										
Launch Operation 1.21										
Prog. Planning & Mgmt ** .95										
Total \$ 39.24										



FORMAT I  
Sheet 1 (Total)

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATION PHASE COST ESTIMATE

Man-hours in Thousands  
Dollars in Millions

FLIGHT NO. 214

FUNCTION  WORK SUBDIVISION		NON-RECURRING						PRODUCTION		SPARES	LAUNCH OPERATIONS
		Design & Development						FLIGHT ARTICLE			
		R. & D. Eng.		Mfg.	Devel Ground Test	Initial Tooling	Labor	Precur	Total		
		Prime Man-hr. Cost	Subctr	M.T.I. & Support							
Subsystems (From Sheet 2)		263.7	\$ .22		\$ .69	\$ .31	\$ 1.29	\$ 2.46	\$ 3.75	\$ 1.29	\$ 1.10
Non-Subsystem Eng. *		\$ 2.52		\$ 1.08	\$ 1.80						
Experiment C/O, Instal, & Integrated C/O		\$ 232.3			.34	\$ .01	\$ .16	\$ 0	\$ .16		
Sub-Totals		\$ 496.0	\$ .22	\$ 1.08	\$ 2.83	\$ .32		Total	\$ 3.91		
Design & Devel. Total		\$ 4.94			\$ 9.07						
				Support							
G.S.E.		287.5	\$ .10	\$ 3.14						\$ .52	
Trainers		\$ 2.75									
		6.4	\$ .03	\$ .12					Total	\$ 1.81	
Training & Handbooks		\$ .06									
		15.7	\$ 0								
Totals		\$ .13									
		309.6	\$ .13	\$ 3.26	\$ 6.33						
Program Planning & Management **		\$ 2.94									
		70.8	\$ .26		\$ .91						
		\$ .65									
Design & Development \$ 9.07											
Initial Tooling .32											
Support 6.33											
Production 3.91											
Spares 1.81											

Design & Development \$ 9.07  
Initial Tooling .32  
Support 6.33  
Production 3.91  
Spares 1.81  
Launch Operation 1.10  
Prog. Planning & Mgmt \*\* .91  
Total \$ 23.45

\*Includes: G.N.&C. Analysis & Integration  
Electronic Integration  
Structural Analysis  
Thermodynamics  
Mass Properties  
Crew Systems  
Sys. Analysis & Integration  
Flt. Test Mission Planning  
Reliability  
System Simulation

\*\*Includes:  
Program Management  
Program Planning  
Quality Program  
Configuration Mgmt  
Data Mgmt  
Reproduction  
Travel & Field Expense

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FORMAT I  
Sheet 2 (Subsystems)

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FLIGHT NO. 214

Man-hours in Thousands  
Dollars in Millions

COLLAIRS IN MILLIONS

Function  Work Subdivision		Design & Development				Initial Tooling	Production			Spares
		R & D Engineering		Devel Ground Test	Total		Flight Article			
		Prime Man-hr	Subctr				Labor	Procur	Total Cost	
Structure (1)		67.3 \$	\$ 0	\$ .02	\$ .65	\$ .17	\$ .22	\$ 0	\$ .22	\$ .02
Crew Provisions (2)		45.9 \$	\$ .22	.15	.81	.07	.16	.77	.93	.11
Environ Control		21.5 \$	\$ 0	.21	.42	.01	.14	.09	.23	.07
Electric Power		41.5 \$	\$ 0	.03	.43	.04	.14	.33	.47	.08
Reaction Control		1.9 \$	\$ 0	0	.02	0	0	0	0	0
Communications		30.8 \$	\$ 0	.05	.34	0	.12	.26	.38	.44
Guid, Nav, & Control (3)		39.2 \$	\$ 0	.07	.44	0	.22	1.00	1.22	.56
Instrumentation		15.0 \$	\$ 0	.02	.17	.01	.03	.01	.04	.01
Propulsion		0 \$	\$ 0	0	0	0	0	0	0	0
Final Assy & Accept Test (4)		.6 \$	\$ 0	.14	.15	.01	.26	0	.26	—
TOTALS		263.7 \$	\$ .22	\$ .69	\$ 3.43	\$ .31	\$ 1.29	\$ 2.46	\$ 3.75	\$ 1.29

- NOTES: (1) Includes Mechanical and Electroexplosive Devices  
 (2) Includes Displays and Controls & Photographic Subsystem  
 (3) Does Not Include G.F.E. Guidance Computer  
 (4) Compatibility Equipment-Installation & Checkout

FORMAT I  
Sheet 1 (Total)  
FLIGHT NO. 511

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATION PHASE COST ESTIMATE

Man-hours in Thousands  
Dollars in Millions

FUNCTION  WORK SUE DIVISION		NON-RECURRING						PRODUCTION		SPARES	LAUNCH OPERATIONS
		Design & Development				Initial Tooling	FLIGHT ARTICLE				
		R. & D. Eng.		Mfg.	Labor		Procur	Total			
		Prime Man-hr. Cost	Subctr	M.T.I. & Support					Devel Ground Test		
Subsystems (From Sheet 2)		80.9	\$ .52		\$ .27	\$ .11	\$ .95	\$ .93	\$ 1.88	\$ .26	
Non-Subsystem Eng. *		91.8		\$ .45	\$ .76						\$ .96
Experiment C/O, Instal, & Integrated C/O		0				\$ .01	\$ .31	\$	\$ .31		
Sub-Totals		172.7	\$ .52	\$ .45	\$ 1.03	\$ .12		Total	\$ 2.19		
Design & Devel. Total					\$ 3.65						
				Support						\$ .05	
G.S.E.		49.1	\$ .02	\$ .15							
Trainers		4.3	\$ 0	\$ 0					Total	\$ .31	
Training & Handbooks		18.4	\$ 0								
Totals		71.8	\$ .02	\$ .15	\$ .83						
Program Planning & Management **		60.0	\$ .25		\$ .82						
		\$ .57									
*Includes: G.N.&C. Analysis & Integration      **Includes: Program Management Electronic Integration      Program Management											
Design & Development \$ 3.65											
Initial Tooling .12											
Support .83											
Production 2.19											
Spares .31											
Launch Operation .96											
Prog. Planning & Mgmt ** .82											
Total \$ 8.88											

Quamman



PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATION PHASE COST ESTIMATE

FORMAT I  
Sheet 1 (Total)

FLIGHT NO. 216

Man-hours in Thousands  
Dollars in Millions

FUNCTION  WORK SUBDIVISION		NON-RECURRING						PRODUCTION		SPARES	LAUNCH OPERATIONS
		Design & Development						FLIGHT ARTICLE			
		R. & D. Eng.		Mfg.		Initial Tooling	Labor	Procure	Total		
		Prime Man-hr. Cost	Subctr	M.T.I. & Support	Devel Ground Test						
Subsystems (From Sheet 2)		186.8	\$ .41		\$ .73	\$ .42	\$ 1.33	\$ 1.70	\$ 3.03	\$ .24	
Non-Subsystem Eng. *		215.5		\$ 1.13	\$ 1.65						\$ 1.11
Experiment C/O, Instal, & Integrated C/O		0			.41	\$ 0	\$ .18	\$ 0	\$ .18		
Sub-Totals		402.3	\$ .41	\$ 1.13	\$ 2.79	\$ .42		Total	\$ 3.21		
Design & Devel. Total					\$ 8.42						
				Support							
G.S.E.		145.7	\$ .03	\$ 2.72						\$ .46	
Trainers		4.8	\$ .03	\$ .12							
Training & Handbooks		8.4	\$ 0								
		.07									
Totals		158.9	\$ .06	\$ 2.84	\$ 4.40						
		1.50									
Program Planning & Management **		70.4	\$ .24		\$ .90						
		.66									
								Total	\$ .70		

\*Includes: G.N.&C. Analysis & Integration  
Electronic Integration  
Structural Analysis  
Thermodynamics  
Mass Properties  
Crew Systems  
Sys. Analysis & Integration  
Flt. Test Mission Planning  
Reliability  
System Simulation

\*\*Includes:  
Program Management  
Program Planning  
Quality Program  
Configuration Mgmt  
Data Mgmt  
Reproduction  
Travel & Field Expense

Design & Development \$ 8.42  
Initial Tooling .42  
Support 4.40  
Production 3.21  
Spares .70  
Launch Operation 1.11  
Prog. Planning & Mgmt \*\* .90  
Total \$ 19.16

FORMAT I  
Sheet 2 (Subsystems)

PHASE I LABS-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

Man-hours in Thousands  
Dollars in Millions

FLIGHT NO. 216

Function  Work Subdivision		Design & Development					Production				Spares
		R & D Engineering		Devel Ground Test	Total	Flight Article					
		Prime Man-hr	Subctr			Initial Tooling	Labor	Procur	Total Cost		
										Cost	
Structure (1)		66.5	\$ 0	\$ .14	\$ .78	\$ .24	\$ .25	\$ 0	\$ .25	\$ .03	
Crew Provisions (2)		43.1	\$ .41	.08	.91	.10	.21	1.11	1.32	.06	
Environ Control		17.2	\$ 0	.31	.47	.01	.11	.09	.20	.01	
Electric Power		28.1	\$ 0	.03	.30	.05	.18	.40	.58	.10	
Reaction Control		2.2	\$ 0	0	.02	0	0	0	0	0	
Communications		10.9	\$ 0	.03	.14	0	.12	.04	.16	.01	
Guid, Nav, & Control (3)		4.0	\$ 0	.11	.15	0	.08	.03	.11	.02	
Instrumentation		14.2	\$ 0	.03	.17	.01	.03	.03	.06	.01	
Propulsion		0	\$ 0	0	0	0	0	0	0	0	
Final Assy & Accept Test (4)		.6	\$ 0	0	.01	0	0	0	0	—	
TOTALS		186.8	\$ .41	\$ .73	\$ 2.95	\$ .42	\$ .98	\$ 1.70	\$ 2.68	\$ .24	

- NOTES: (1) Includes Mechanical and Electroexplosive Devices  
 (2) Includes Displays and Controls & Photographic Subsystem  
 (3) Does Not Include G.F.E. Guidance Computer  
 (4) Compatibility Equipment-Installation & Checkout

Man-Hours in Thousands  
Dollars in Millions

PHASE I LAB-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FORMAT II

FLIGHT NO. 507

COST ELEMENTS	Rate	%	ON SITE				OFF SITE		
			NON-RECURRING		RECURRING		Man-hr	Cost	Total Cost
Engineering Engineering Overhead Service, Pubs., Repro. Overhead Total	5.21	---	1268.0	6.61	82.3	.43	298.0	1.53	8.57
	---	68.2	---	4.53	---	.28	---	1.04	5.85
	4.00	---	50.2	.20	0	0	---	0	.20
	---	68.2	---	.13	---	0	---	0	.13
Manufacturing Production Overhead Inspection Overhead Tool Fabrication Overhead Shipping Overhead Total	---	---	1318.2	11.47	82.3	.71	298.0	2.57	14.75
	3.19	---	259.7	.83	132.2	.42	34.4	.11	1.36
	---	162.5	---	1.35	---	.68	---	.18	2.21
	3.88	---	40.6	.15	10.8	.05	2.7	.01	.21
	---	162.5	---	.25	---	.07	---	.02	.34
	3.22	---	369.7	1.19	4.8	.0	---	0	1.19
	---	162.5	---	1.93	---	.0	---	0	1.93
	2.99	---	0	.0	---	.01	---	0	.01
Program Coordination Total	---	---	---	.0	---	.02	---	0	.02
	---	---	670.0	5.70	147.8	1.25	37.1	.32	7.27
Procurement Mat'l & Minor Subcontr.* Maj. Subcontractors Total	5.38	---	7.4	.04	0	0	0	0	.04
	---	---	---	---	---	---	---	---	---
	---	---	---	9.90	---	1.90	---	.10	11.90
	---	---	---	9.90	---	1.90	---	.10	11.90
Travel Per Diem Transportation Costs Total	---	---	---	0	---	0	---	.01	.01
	---	---	---	0	---	0	---	.02	.02
	---	---	---	0	---	0	---	.03	.03
	---	---	---	27.11	---	3.86	---	3.02	33.99
G & A Expense TOTAL COST	---	7.8	---	2.09	---	.29	---	.25	2.63
	---	---	---	29.20	---	4.15	---	3.27	36.62
FLIGHT TOTAL COST									36.62

\* Included with Major Subcontracts

Grumman

Man-Hours in Thousands  
Dollars in Millions

PHASE I LAB-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FORMAT II

FLIGHT NO. 509

COST ELEMENTS	Rate	%	ON SITE				OFF SITE			
			NON-RECURRING		RECURRING		Man-hr	Cost	Man-hr	Total Cost
			Man-hr	Cost	Man-hr	Cost				
Engineering Engineering Overhead Service, Pubs., Repro. Overhead Total	5.27 --- 3.82 --- ---	--- 68.2 --- 68.2 ---	1231.0 --- 22.6 --- 1253.6	6.48 4.41 .09 .06 11.04	107.6 --- --- --- 107.6	.57 .39 0 0 .96	199.8 --- --- --- 199.8	1.05 .72 0 0 1.77	199.8 --- --- --- 199.8	8.10 5.52 .09 .06 13.77
Manufacturing Production Overhead Inspection Overhead Tool Fabrication Overhead Shipping Overhead Total	3.19 --- 3.92 --- 3.26 --- 3.12 ---	--- 162.5 --- 162.5 --- 162.5 --- 162.5 ---	238 --- 43.0 --- 366.7 --- 0 --- 647.7	.77 1.23 .16 .28 1.19 1.92 0 0 5.55	110.4 --- 6.0 --- 0 --- 4.5 --- 120.9	.35 .57 .03 .04 0 0 .01 .02 1.02	30.4 --- 2.2 --- 2.0 --- 0 --- 34.6	.09 .15 .01 .01 .01 .01 0 0 .28	30.4 --- 2.2 --- 2.0 --- 0 --- 34.6	1.21 1.95 .20 .33 1.20 1.93 .01 .02 6.85
Program Coordination	6.06	---	46.5	.04	---	0	---	0	---	.04
Procurement Mat'l & Minor Subcontr.* Maj. Subcontractors Total	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- 11.04 11.04	--- --- --- ---	--- 4.55 4.55	--- --- --- ---	--- .11 .11	--- --- --- ---	--- 15.70 15.70
Travel Per Diem Transportation Costs Total	--- --- --- ---	--- --- --- ---	--- --- --- ---	0 0 0	--- --- --- ---	0 0 0	--- --- --- ---	.01 .02 .03	--- --- --- ---	--- --- --- ---
Sub-Total	---	---	---	27.67	---	6.53	---	2.19	---	36.39
G & A Expense	---	7.8	---	2.16	---	.51	---	.18	---	2.85
TOTAL COST	---	---	---	29.83	---	7.04	---	2.37	---	39.24
FLIGHT TOTAL COST										39.24

\* Included with Major Subcontracts

Man-Hours in Thousands  
Dollars in Millions

PHASE I LAB-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FORMAT II

FLIGHT NO. 214

COST ELEMENTS	Rate	%	ON SITE			OFF SITE		
			NON-RECURRING		RECURRING			
			Man-hr	Cost	Man-hr	Cost	Man-hr	Cost
Engineering								
Engineering	5.32	---	907.2	4.83	81.4	.43	174.5	.93
Overhead	---	68.2	---	3.29	---	.29	---	.63
Service, Pubs., Repro.	3.75	---	16.7	.06	0	0	0	0
Overhead	---	68.2	---	.04	---	0	---	0
Total	---	---	923.9	8.22	81.4	.72	174.5	1.56
Manufacturing								
Production	3.22	---	222.5	.72	127.2	.41	47.7	.15
Overhead	---	162.5	---	1.16	---	.67	---	.25
Inspection	3.80	---	39.9	.14	10.8	.04	.5	.01
Overhead	---	162.5	---	.25	---	.06	---	.01
Tool Fabrication	3.27	---	314.5	1.03	0	0	0	0
Overhead	---	162.5	---	1.67	---	0	---	0
Shipping	3.05	---	0	0	4.5	.01	0	0
Overhead	---	162.5	---	0	---	.02	---	0
Total	---	---	576.9	4.97	142.5	1.21	48.2	.42
Program Coordination			10.2	.06	0	0	0	0
Procurement								
Mat'l & Minor Subcontr.*	---	---	---	---	---	---	---	---
Maj. Subcontractors	---	---	---	3.32	---	1.20	---	.04
Total	---	---	---	3.32	---	1.20	---	.04
Travel								
Per Diem	---	---	---	---	---	---	---	.01
Transportation Costs	---	---	---	---	---	---	---	.02
Total	---	---	---	0	---	0	---	.03
Sub-Total	---	---	---	16.57	---	3.13	---	2.05
G & A Expense	---	---	---	1.29	---	.25	---	.16
TOTAL COST	---	---	---	17.86	---	3.38	---	2.21
FLIGHT TOTAL COST								23.45

\* Included with Major Subcontracts

Quamman

Man-Hours in Thousands  
Dollars in Millions

PHASE I LAB-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FORMAT II

FLIGHT NO. 511

COST ELEMENTS	Rate		%	ON SITE				OFF SITE		
				NON-RECURRING		RECURRING		Man-hr	Cost	Total Cost
				Man-hr	Cost	Man-hr	Cost			
Engineering Engineering Overhead Service, Pubs., Repro. Overhead Total	5.53 ----- 3.97 ----- -----	----- 68.2 ----- 68.2 -----	----- 68.2 ----- 68.2 -----	360.6 ----- 15.3 ----- 375.9	2.00 1.36 .06 .04 3.46	90.1 ----- 0 ----- 90.1	.50 .34 .0 .84	0 ----- 0 ----- 0	0 0 0 0	2.50 1.70 .06 .04 4.30
Manufacturing Production Overhead Inspection Overhead Tool Fabrication Overhead Shipping Overhead Total	3.39 ----- 3.99 ----- 3.40 ----- 3.13 ----- -----	----- 162.5 ----- 162.5 ----- 162.5 ----- 162.5 -----	----- 162.5 ----- 162.5 ----- 162.5 ----- 162.5 -----	56.7 ----- 21.7 ----- 95.8 ----- 0 ----- 174.2	.19 .31 .09 .14 .04 .05 0 .82	73.2 ----- 11.6 ----- 0 ----- 4.8 ----- 89.6	.25 .41 .04 .07 0 0 .01 .02	.08 .13 .01 .01 0 0 0 .23	24.8 ----- 1.7 ----- 0 ----- 0 ----- 26.5	.52 .85 .14 .22 .04 .05 .01 .02 1.85
Program Coordination	-----	-----	-----	9.3	.05	-----	-----	-----	-----	.05
Procurement Mat'l & Minor Subcontr.* Maj. Subcontractors Total	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----	----- 1.41 1.41	----- ----- ----- -----	----- .59 .59	----- .01 .01	----- ----- ----- -----	----- 2.01 2.01 -----
Travel Per Diem Transportation Costs Total	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----	0 0 0 5.74	----- ----- ----- -----	0 0 0 2.23	.01 .02 .03 .27	----- ----- ----- -----	----- ----- .03 8.24
Sub-Total	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
G & A Expense	-----	-----	-----	-----	.45	-----	.17	-----	.02	.64
TOTAL COST	-----	-----	-----	-----	6.19	-----	2.40	-----	.29	8.88

\* Included with Major Subcontracts

Man-Hours in Thousands  
Dollars in Millions

PHASE I LAB-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FORMAT II

FLIGHT NO. 216

COST ELEMENTS	Rate	%	ON SITE				OFF SITE		
			NON-RECURRING		RECURRING		Man-hr	Cost	Total Cost
			Man-hr	Cost	Man-hr	Cost			
Engineering Engineering Overhead Service, Pubs., Repro. Overhead Total	5.44 ---- ---- ---- ----	68.2 ---- ---- ---- ----	787.7 ---- 13.5 ---- 801.2	4.27 2.92 .05 .03 7.27	83.4 ---- 0 ---- 83.4	.45 .31 0 0 .76	44.6 ---- 0 ---- 44.6	.26 .17 0 0 .43	4.98 3.40 .05 .03 8.46
Manufacturing Production Overhead Inspection Overhead Tool Fabrication Overhead Shipping Overhead Total	3.19 ---- 3.88 ---- 3.33 ---- ---- ----	162.5 ---- 162.5 ---- 162.5 ---- ---- ----	240.1 ---- 22 ---- 300.7 ---- 0 ---- 562.8	.77 1.26 .08 .13 1.00 1.63 0 0 4.87	135. ---- 31.3 ---- 0 ---- 5.6 ---- 171.9	.43 .72 .12 .20 0 0 .02 .03 1.52	24. ---- .8 ---- 0 ---- 0 ---- 24.8	.08 .10 .01 .01 0 0 0 0 .20	1.28 2.03 .21 .34 1.00 1.63 .02 .03 6.59
Program Coordination	----	----	12.1	.08	----	----	----	----	.08
Procurement Mat'l & Minor Subcontr.* Maj. Subcontractors Total	---- ---- ---- ----	---- ---- ---- ----	---- ---- ---- ----	---- 1.74 1.74 ----	---- ---- ---- ----	---- .86 .86 ----	---- ---- ---- ----	---- .02 .02 ----	---- 2.62 2.62 ----
Travel Per Diem Transportation Costs Total	---- ---- ---- ----	---- ---- ---- ----	---- ---- ---- ----	0 0 0 13.96	---- ---- ---- ----	0 0 0 3.14	---- ---- ---- ----	.02 .01 .03 .68	.02 .01 .03 17.78
Sub-Total	----	----	----	----	----	----	----	.05	1.38
G & A Expense	----	----	----	15.05	----	3.38	----	.73	----
TOTAL COST	----	----	----	----	----	----	FLIGHT TOTAL COST	----	19.16

\* Included with Major Subcontracts

*Gumman*

Man-Hours in Thousands  
Dollars in Millions

PHASE I LAB-EXPERIMENT INTEGRATION  
DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

FORMAT II

FLIGHT NO. ALL (5)

COST ELEMENTS	Rate	%	ON SITE			OFF SITE		
			NON-RECURRING		RECURRING		Cost	Total Cost
			Man-hr	Cost	Man-hr	Cost	Man-hr	
Engineering Engineering Overhead Service, Pubs., Repro. Overhead Total	---	---	15,966.5 --- 118.3 ---	24.19 16.51 .46 .30 41.46	444.8 --- 0 ---	2.38 1.61 0 0 3.99	716.9 --- 0 ---	3.77 2.56 0 0 6.33
Manufacturing Production Overhead Inspection Overhead Tool Fabrication Overhead Shipping Overhead Total	---	---	1017.0 --- 167.2 --- --- 1447.4 ---	3.28 5.31 .62 1.05 4.45 7.20 0 0 21.91	578.0 --- 70.5 --- 4.8 --- 19.4 ---	1.86 3.05 .28 .44 .06 .11 0 0 5.80	161.3 --- 7.9 --- 2.0 --- 0 ---	.51 .81 .05 .06 .01 .01 0 0 1.45
Program Coordination	---	---	46.4	.27	0	0	0	0
Procurement Mat'l & Minor Subcontr.* Maj. Subcontractors Total	---	---	---	---	---	---	---	---
Travel Per Diem Transportation Costs Total	---	---	---	0 0 0	---	0 0 0	---	.10 .05 .15
Sub-Total	---	---	---	91.05	---	18.89	---	8.21
G & A Expense	---	---	---	7.08	---	1.46	---	.66
TOTAL COST	---	---	---	98.13	---	20.35	---	8.87
FLIGHT TOTAL COST								127.35

\* Included with Major Subcontracts

Dollars in Millions

PHASE I LAB - EXPERIMENT INTEGRATION

DEVELOPMENT/OPERATIONS PHASE COST ESTIMATE

COST SPREAD BY CALENDAR YEAR

FLIGHT NO.	COST CATEGORY	CALENDAR YEARS				TOTAL
		1966	1967	1968	1969	
507	Grumman Procurement	\$ 3.75	\$ 13.16	\$ 6.60	\$ .25	\$ 23.76
	Total	\$ 2.57	7.07	3.09	.13	12.86
509	Grumman Procurement	\$ 6.32	20.23	9.69	.38	36.62
	Total	\$ .98	\$ 11.40	\$ 8.76	\$ 1.14	\$ 22.28
214	Grumman Procurement	\$ 1.71	9.31	5.09	.85	16.96
	Total	\$ 2.69	20.71	13.85	1.99	39.24
511	Grumman Procurement	\$ .54	\$ 6.80	\$ 9.06	\$ 2.11	\$ 18.51
	Total	.49	2.21	1.96	.28	4.94
216	Grumman Procurement	\$ 1.03	9.01	11.02	2.39	23.45
	Total	\$ .18	\$ 1.36	\$ 2.43	\$ 2.72	\$ 6.69
All Flights	Grumman Procurement	\$ .04	.44	.83	.88	2.19
	Total	\$ .22	1.80	3.26	3.60	8.88
216	Grumman Procurement	\$ .21	\$ 3.40	\$ 7.35	\$ 5.35	\$ 16.31
	Total	.14	.75	1.39	.57	2.85
All Flights	Grumman Procurement	\$ .35	4.15	8.74	5.92	19.16
	Total	\$ 5.66	\$ 36.12	\$ 34.20	\$ 11.57	\$ 87.55
All Flights	Grumman Procurement	\$ 4.95	19.78	12.36	2.71	39.80
	Total	\$ 10.61	55.90	46.56	14.28	127.35

DEVELOPMENT/OPERATION PHASE I LABS-EXPERIMENT INTEGRATION FORMAT IV

TABLE OF LABOR AND OVERHEAD RATES USED

COST ELEMENTS	CALENDAR YEARS					
	1966*		1967*		1968	
	Lab.	O.H. %	Lab.	O.H. %	Lab.	O.H. %
Engineering						
Engineering (1)	\$4.97		\$5.18		\$5.39	
Serv., Pubs., Repro	3.66	67.6	3.76	68.2	3.91	68.2
Manufacturing						
Production	3.03		3.10		3.19	
Inspection	3.59		3.69		3.80	
Tool Fab. (2)	3.07		3.17		3.27	
Shipping	2.79	162.0	2.89	162.5	2.98	162.5
Program Coordination (3)	5.66	-----	5.87	-----	6.10	-----
General & Admin. O.H.		7.9		7.8		7.8

\*Negotiated rates.

Notes: (1) Includes Engineering Design, Flight Test, Tool Design, and Support Engineering.

(2) Includes Tool Fabrication and Support Fabrication.

(3) Includes Contracts, Program Management, and Purchasing.